

# Pharmacognostical Studies on the Chinese Crude Drug “Xuelianhua” and Related Ethnomedicines (Part 4) On Botanical Origins of the Chinese “Xuelianhua” and Tibetan “sPang-rtzi” Derived from Species of Sect. *Eriocoryne* of Genus *Saussurea*

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In previous papers, we anatomically confirmed the botanical origins of the Chinese “Xuelianhua” and related crude drugs. They were shown to be derived from plants of subgenera *Eriocoryne* and *Amphilaena* of the genus *Saussurea* (Compositae). However, some samples circulated in the market were damaged by insects and/or shaking during transportation, and leaves were broken into fragments too small for anatomical scrutiny. In those samples, large amounts of woolly hairs were found and derived from subgen. *Eriocoryne*. In order to clarify the origin of such samples, morphological observations of the flowers, achenes, and pollen grains of *Eriocoryne* plants were carried out. We found that 12 species of subgen. *Eriocoryne* plants are distinguished by the following characteristics; the appearance of bristles consisting of emergences on the receptacle, the presence of coronule on achenes, pappus color, the presence of glandular hairs on the involucrel phyllaries, corolla tube and achenes and variation in ornamentation of pollen exine. Based on these results, the origins of “Xuelianhua” from Hongkong and “sPang-rtzi” from Golmud, Qinghai were identified to be a mixture of flowering whole plants of *S. namikawae* and *S. medusa*, and those of *S. quercifolia*, respectively.

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**Key words:** Pharmacognostical study, *Saussurea*, sPang-rtzi, subgenus *Eriocoryne*, Xuelianhua.

The botanical origin of traditional Chinese medicine, “Xuelianhua” and its related drugs have been reported to come from whole plants of (mainly aerial parts) of species from subgenera *Eriocoryne* and *Amphilaena* of the genus *Saussurea* (Compositae) (Health Bureau of Autonomous Region of Xizang 1973, Meyen 1983, Liu 1985, Lian and Xiao 1985, Xie 1994). In previous pa-

pers (Yang et al. 1997), the botanical origins of the crude drugs on the market were determined to be several species of subgen. *Eriocoryne* and *S. involucreata* or *S. obvallata* of subgen. *Amphilaena* by anatomical studies of the leaf, stem, and root. However, *Saussurea* plants can easily be damaged by insects and/or broken apart by shaking-up during transportation. Some commercial

samples contained no intact leaves, making anatomical identification difficult. Flowers were also broken into fragments which were too small to identify by ordinary morphological taxonomic methods. The presence of many woolly hairs in the residue suggested the samples were derived from plants belonging to subgen. *Eriocoryne* of *Saussurea*. In order to identify such samples, observation of the morphological characteristics of flower, achenes, and receptacles were made, and based on the results, the origins of "Xuelianhua" from Hongkong and "sPang-

rtzi" from Golmud, Qinghai Prov., were identified.

### Materials and Methods

Herbarium specimens examined are deposited in the Museum of Materia Medica, Institute of Natural Medicine, Toyama Medical and Pharmaceutical University (TMPW), except for some specimens loaned from Kyoto University (KYO) and the National Science Museum, Tokyo (TNS) (Table 1). The specimens are consistent with those cited in the previous paper (Yang et al.

Table 1. Materials examined of *Saussurea* plants

Scientific name/Locality	Collector & Specimen No.	Date
<i>S. medusa</i> Maxim.		
CHINA: Sichuan Prov., Kanding Co.	R. P. Yang & al. 21	Jul., 1994
CHINA: Yunnan Prov., Zhongdian Co.	R. P. Yang & al. 31	Aug., 1994
CHINA: Yunnan Prov., Zhongdian Co.	Z. D. Fang 715	Jul., 1987
<i>S. laniceps</i> Hand.-Mazz.		
CHINA: Sichuan Prov., Jiulong Co.	R. P. Yang & al. 29	Aug., 1994
CHINA: Yunnan Prov., Deqin Co.	Z. D. Fang 237	Jul., 1987
<i>S. tridactyla</i> Sch.Bip ex Hook.f.		
NEPAL: Eastern Nepal, Lhonak	K. Nishioka 1119 (KYO)	Sept., 1962
<i>S. namikawae</i> Kitam.		
CHINA: Yunnan Prov., Deqin Co.	Meili Expedition Team 26534	Aug., 1992
CHINA: Qinghai Prov.	no collector's name 3437	no date
NEPAL: Near Pijher	K. Nishioka 447 (KYO)	Sept., 1958
<i>S. gossypiphora</i> D.Don		
NEPAL: Central Nepal, Rolwaling Khola	H. Ohba & al. 8351343 (KYO)	Sept., 1983
<i>S. nishiokae</i> Kitam.		
NEPAL: Central Nepal, Gorkha Dist.	T. Namba 1023001	Sept., 1963
NEPAL: Central Nepal, Gorkha Dist.	T. Namba 1022009 (KYO)	Sept., 1963
<i>S. leucoma</i> Diels		
CHINA: Yunnan Prov., Deqin Co.	R. P. Yang & al. 37	Aug., 1994
<i>S. quercifolia</i> W.W.Smith		
CHINA: Sichuan Prov., Jiulong Co.	G. H. Tang & al. 48	Aug., 1994
CHINA: Yunnan Prov., Deqin Co.	Z. D. Fang 1087	Sept., 1988
<i>S. eriocephala</i> Franch.		
CHINA: Yunnan Prov., Deqin Co.	Meili Expedition team 26403	Aug., 1992
<i>S. simpsoniana</i> (Field. & Gardn.) Lipsch.		
NEPAL: Dhaulagiri Zone, Mustang Dist.	T. Namba & al. N-8114	Sept., 1986
NEPAL: Dhaulagiri Zone, Mustang Dist.	T. Namba & al. N-7684	Sept., 1986
<i>S. stella</i> Maxim.		
CHINA: Sichuan Prov., Kanding Co.	R. P. Yang & al. 6	Jul., 1994
CHINA: Yunnan Prov., Zhongdian Co.	Z. D. Fang 29564	Sept., 1987
<i>S. Kingii</i> C.E.Fisch.		
CHINA: Tibet, suburbs of Lhasa	E. Kawaguchi 96929 (TNS)	the 19 century

1997). Almost all of the specimens were botanically identified by Prof. Hiroshige Koyama, Department of Botany, National Science Museum, Tokyo, Japan. Taxonomic system is according to Lipshitz (1979).

Commercial crude drug samples examined are as follows:

- 1) "Xuelianhua (雪蓮花)": Wintaihong Medicine (永大行藥行), Hongkong. (Dec., 1974, TMPW No. 2255).
- 2) "Xuelian (雪蓮, also sold as Tibetan "sPang-rtzi)": Tibetan and Mongolian Medicine Outpatient Section, People's Hospital of Golmud City, Qinghai Prov., China (Sept. 1990, TMPW No. 11335).

Morphological observations were made with a stereoscope. Floral characters examined were; the appearance and color of the bristle on the receptacle; involucre bracts characteristics such as the shapes of the out-

line, apex, and margin, appearance of hairs, and length and width of the innermost and the outermost phyllaries; the appearance of clavate hairs on the corolla and the length of the tube and lobe, and their ratio; pappus color; and achene characteristics including outline, color, length, the appearance of clavate hairs and coronule. Pollen grains were observed with scanning electron microscope (JSM-5310LV, JEOL) at 10 kV of accelerate voltage after fixation in FAA (formic acid-acetic acid-ethanol) solution, treated with acetone, dried naturally, and spattered with 250 Å thickness of gold. Palynological characteristics observed included equatorial and polar diameters, shapes and ornamentation.

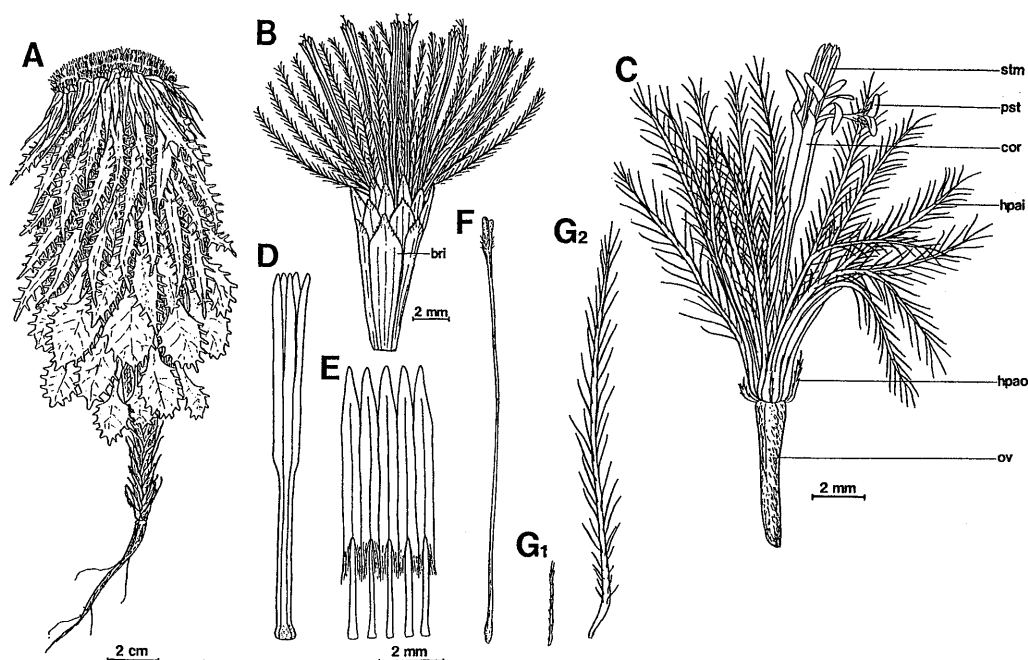


Fig. 1. *Saussurea medusa* (R. P. Yang 31). A. Entire plant. B. Capitulum. C. Flower. D. Corolla. E. Stamen. F. Pistil. G<sub>1</sub>. Pappus of outer layer. G<sub>2</sub>. Pappus of inner layer. Abbreviation: bri, involucre bract; cor, corolla; hpai, pappus of inner layer; hpao, pappus of outer layer; ov, ovary; pst, pistil; stm, stamen.

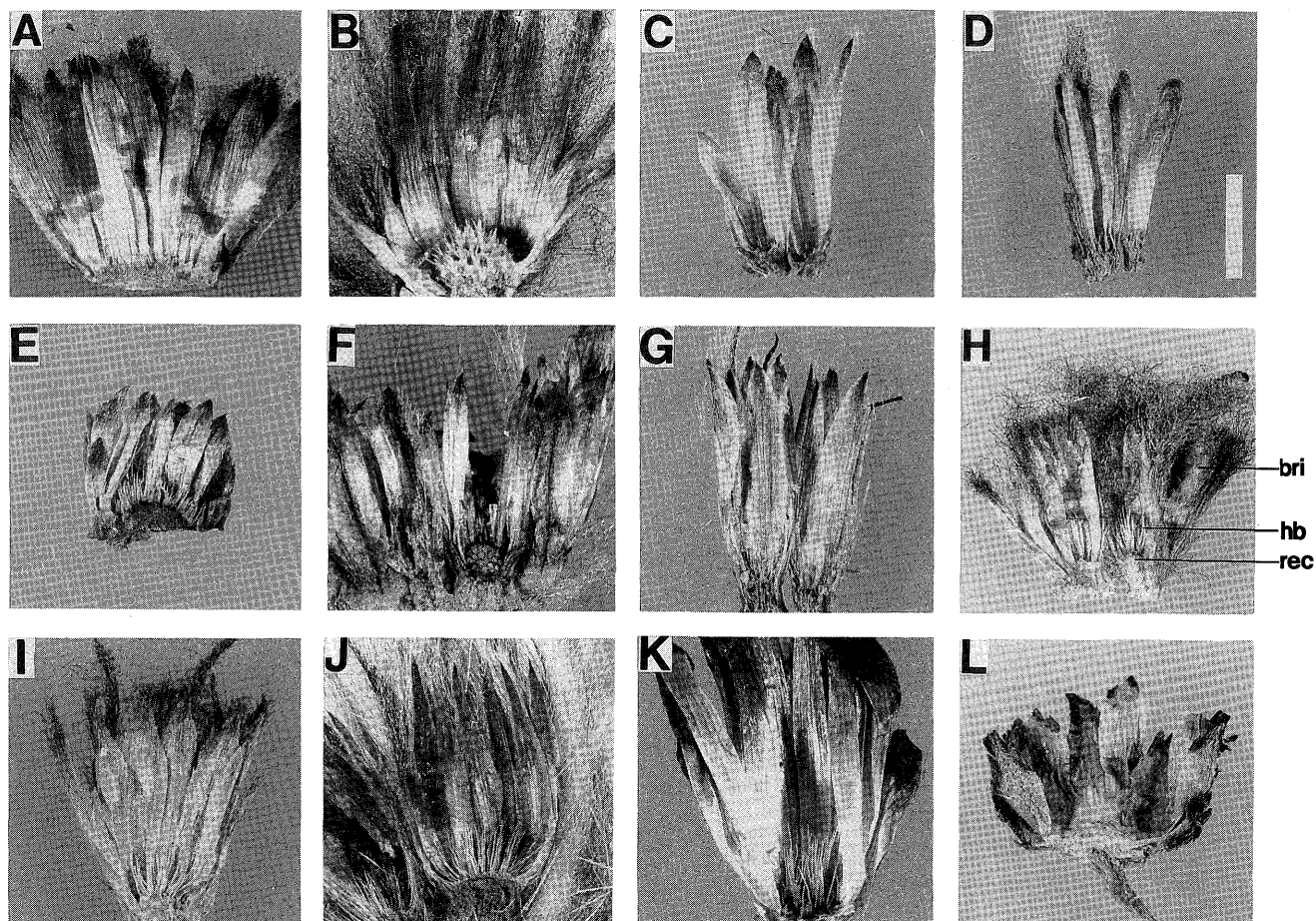


Fig. 2. Receptacles of *Saussurea* subgenus *Eriocoryne* species. A. *S. medusa* (R. P. Yang 21). B. *S. laniceps* (R. P. Yang & al. 29). C. *S. tridactyla* (Nishioka 1119, KYO). D. *S. namikawae* (Meili Expedition Team 26534). E. *S. gossypiphora* (Ohba & al. 8351343, KYO). F. *S. nishiokae* (Namba 1023001). G. *S. leucoma* (R. P. Yang & al. 37). H. *S. quercifolia* (G. H. Tang & al. 48). I. *S. eriocephala* (Meili Expedition team 26403). J. *S. simpsoniana* (Namba & al. N-7684). K. *S. stella* (Z. D. Fang 29564). L. *S. kingii* (Kawaguchi 96929, TNS). Abbreviation: bri, involucral phyllary; hb, bristle; rec, receptacle. Scale bar = 5 mm.

## Results

### Description of general morphology of *Saussurea* subgenus *Eriocoryne*

Plant lanate, lacking thin bracts. Capitula crowded on dilated solitary stem (Fig. 1). Receptacle usually setose (Fig. 2); bristles consisting of emergences (Fig. 3); emergences heterocellular, composed of epidermal and ground tissues without any conductive tissues; epidermis thick-walled parenchymatous, ground tissue usually thick-walled parenchymatous, sometimes parenchymatous in transection. Achenes smooth, obviously ribbed (Fig. 4), sometimes pubescent with clavate hairs; clavate hairs glandular, stalk uniseriate or biseriate multicellular, head multicellular, localized near the base of pappi or scattered over the whole achenes, involucrel phyllaries and corolla tube. Involucrel phyllaries densely archnoid (Fig.

5), sparingly pubescent with clavate hairs near the apex, entire or serrate at margin; outermost ones linear to ovate; innermost ones linear to oblong. Corolla tubular, 5-lobed (Fig. 1). Stamens 5, filaments free from each other. Anthers combined into tube, sagittate at base, comb-like branched. Ovary inferior. Pappi usually white to pale yellow, biseriate; outer ones short, spiny; inner ones plumose. Pollen grains trizonocolpate, single, pale yellow or yellow to brown, spheroidal in equatorial, round triangular to round in polar, and 23–35 (–40)  $\mu\text{m}$  in equatorial diameter and 23–31 (–37)  $\mu\text{m}$  in polar diameter. Exine usually perforate with verrucate sculpturing (Moore et al. 1991, Morita 1994).

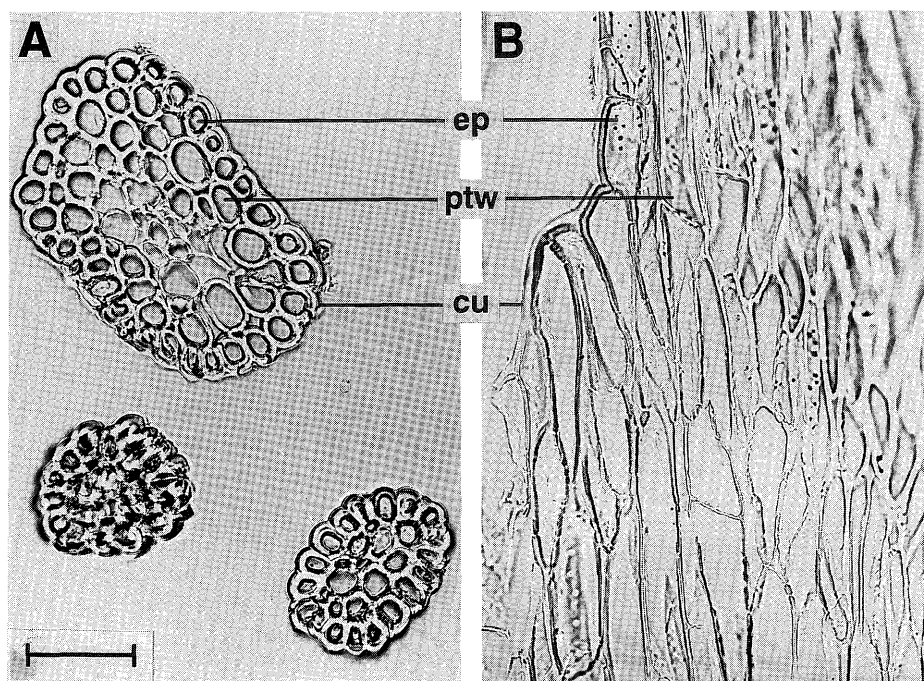


Fig. 3. Bristles in receptacle of *Saussurea gossypiphora* (Ohba & al. 8351343, KYO): Transverse (A) and longitudinal (B) sections. Scale = 50  $\mu\text{m}$ . Abbreviation: ep, epidermis; ptw, thick-walled parenchyma; cu, cuticle.

Table 2. Measurements of floral organs and achenes in the species of *Saussurea* subgenus *Eriocoryne*

Species		<i>S. medusa</i>	<i>S. laniceps</i>	<i>S. tridactyla</i>	<i>S. namikawae</i>	<i>S. gossypiphora</i>
Receptacle						
Bristle		++	++	+	+	+++
Color of bristle		pale yellow -yellow	white	yellow	brown	white- yellow
Involucral phyllary						
Outermost layer	outline	broad linear -obovate	linear	linear oblong -oblong	oblong	ovate
	apex	acuminate -aristate	attenuate- acuminate	acuminate	acuminate -obtuse	obtuse- acuminate
	margin	serrate	entire	serrate	entire	serrate
	length (mm)	9.4-15.0	28.3-40.0	9.1-10.1	7.0-10.1	4.6-5.2
	width (mm)	3.3-7.0	1.1-2.6	3.3-3.8	1.0-4.0	2.5-3.0
	hair	-	+	-	-	+
	glandular non-glandular	white	pale- dark brown	white	white	white
Innermost layer	outline	broad linear- linear oblong	linear lanceolate	linear- broad linear	broad linear -linear	broad linear
	apex	rotundate- acuminate	attenuate -acuminate	acute	acute- obtuse	acuminate
	margin	serrate	entire	serrate	serrate	serrate
	length (mm)	12.1-13.7	12.9-16.0	11.3-12.2	9.5-12.5	5.9-7.2
	width (mm)	1.9-3.8	1.2-1.9	1.5-2.5	1.9-3.2	1.1-1.2
	hair	-	±	-	-	-
	glandular non-glandular	white	white- dark brown	white	white	white
Corolla						
Glandular hair		-	+	-	+++	-
Length of tube (Lt: mm)		7.0-11.0	8.2-9.0	8.6-9.4	7.8-11.5	7.8-8.9
Length of lobe (Ll: mm)		2.3-4.0	1.0-1.9	2.0-2.3	2.0-2.8	2.1-2.3
Ll/Lt		0.23-0.45	0.14-0.23	0.21-0.26	0.18-0.31	0.22-0.23
Stamen						
Length of anther (La: mm)		4.0-5.7	3.6-4.8	3.2-3.7	3.6-4.1	4.3-4.6
Length of filament (Lf: mm)		2.5-4.5	6.0-7.2	2.5-2.8	1.9-2.9	2.4-2.9
La/Lf		1.4-2.0	0.5-0.8	1.2-1.4	1.4-1.9	1.5-1.8
Pistil						
Shape of outline of lobe		linear oblong -ovate	broad linear	linear oblong	broad linear- linear oblong	oblong
Length of whole pistil (mm)		11.0-14.5	11.0-14.5	10.5-11.1	8.7-9.8	10.3-11.4
Length of lobe (mm)		1.0-1.3	1.0-1.4	1.0-1.5	0.9-1.1	0.9-1.1
Pappus						
Outer	color	white- pale yellow	dark brown	pale yellow	pale yellow	pale yellow
	length (mm)	0.5-7.1	2.7-3.8	1.4-2.2	1.1-4.0	3.2-4.8
Inner	color	white- pale yellow	dark brown	white	white	pale yellow
	length (mm)	10.0-13.2	8.1-10.0	11.0-11.9	10.6-11.5	9.3-9.7
Achene						
Outline		oblanceolate -linear	obovate	oblanceolate	broad linear	oblanceolate oblong
Color		silver gray- dark brown	pale brown	dark brown	grey yellow -yellow	black
Length		5.0-8.5	0.9-1.5	3.3-3.8	8.5-9.7	3.0-4.0
Glandular hair		±	-	-	+++	-
Coronule		-	-	-	-	-
Pollen grain						
Equatorial diameter (µm)		30-34	27-30	29-35	26-32	26-29
Polar diameter (µm)		27-33	24-46	26-28	25-27	23-25

Each value is indicated as minimum and maximum.

\*Achenes are immature.

Table 2. Continued

<i>S. nishiokae</i>	<i>S. leucoma</i>	<i>S. quercifolia</i>	<i>S. eriocephala</i>	<i>S. simpsoniana</i>	<i>S. stella</i>	<i>S. kingii</i>
– –	+ brown	+ white– pale yellow	++ white– pale yellow	++ white	++ pale yellow	– –
linear oblong	oblong	oblong	oblong	narrow lanceolate	elliptical– spatulate	lanceolate
mucronate	aristate	attenuate –acuminate	aristate	–lanceolate attenuate –acuminate	rotundate– mucronate	oblong–ovate acuminate
entire	entire	serrate	serrate	entire	entire	serrate
4.6–5.2	13.2–16.9	6.9–8.0	13.0–15.5	10.3–14.0	6.1–10.2	5.6–8.1
2.5–3.0	3.7–4.2	2.6–3.5	3.4–3.9	1.8–2.9	2.7–4.4	3.2–5.1
–	++	+	–	++	+	+
white	white	pale dark brown	dark brown	white	white	pale brown
linear	linear– narrow lanceolate	broad linear– linear oblong	linear lanceolate	linear– broad linear	linear	lanceolate
acuminate	acute	acute	attenuate –acuminate	attenuate –acuminate	elliptical– cuspidate	–oblong attenuate –acuminate
entire	entire	serrate	serrate	entire	entire	serrate
9.5–10.0	9.3–12.2	7.2–8.9	9.6–12.3	8.3–11.5	14.5–18.8	9.7–10.9
1.0–1.6	2.0–3.0	1.6–2.2	1.4–2.2	1.0–2.5	1.1–2.0	2.0–2.5
–	+	–	–	+	–	–
white	white	dark brown	dark brown	white	white	pale brown
–	–	–	–	–	–	–
10.5–11.1	10.2–11.1	5.1–9.5	7.3–8.3	6.0–8.0	12.6–18.1	8.9–9.4
1.5–2.1	2.9–3.4	2.2–4.1	2.5–3.5	2.4–3.0	3.3–4.9	3.3–3.5
0.14–0.20	0.26–0.32	0.42–0.50	0.31–0.48	0.32–0.45	0.22–0.38	0.56–0.67
4.2–4.6	5.0–5.4	3.8–5.2	3.4–4.1	4.2–4.4	6.1–7.4	4.0–4.2
3.0–4.1	2.2–3.0	2.4–4.9	2.9–3.6	4.1–4.7	2.1–3.4	1.6–2.0
1.1–1.5	1.8–2.4	1.1–1.8	1.2–1.6	0.9–1.1	2.3–3.5	2.1–2.6
linear	broad linear	lanceolate	broad linear	linear oblong	linear	linear oblong
12.8–13.9	11.8–12.3	7.8–13.7	10.3–11.3	8.3–11.0	15.0–22.8	7.8–8.9
1.1–1.3	1.0–1.1	1.1–1.5	1.0–1.2	1.0–1.4	1.0–1.8	1.0–1.1
white	pale brown	pale brown	dark brown	white	white	pale yellow
2.5–3.5	1.0–1.9	0.5–4.1	2.7–7.2	3.2–5.8	2.2–3.9	3.1–3.2
white	pale brown	brown– dark brown	dark brown	white	white	pale yellow
12.1–12.9	12.0–12.7	7.5–13.0	9.4–10.7	8.9–11.0	12.7–18.2	8.1–8.8
broad linear	linear oblong	broad linear	oblong	oblanceolate	linear oblong –oblong	oblanceolate
black	brown– dark brown	brown	brown– dark brown	brown– black	pale brown– brown	yellow
5.0–6.3	2.7–3.1	6.5–6.8	2.2–2.4	2.1–3.0	3.0–3.4	2.6–2.7
+++	+	–	–	–	–	–
–	–	–	–	–	+	–
27–32	30–34	27–31	25–33	23–29	36–40	27–33
24–28	27–30	25–28	24–29	23–26	30–37	29–34

## Morphological characteristics of plant materials

Twelve species of *Saussurea* subgenus *Eriocoryne* were readily distinguished by our observations of the floral organs, involucrel phyllaries, achenes, and receptacles (Table 2). They can be identified by the following key:

1. Leaves, stem and residue of degraded samples densely lanate (Sect. *Eriocoryne*)
  2. Receptacles setose
    3. Corollae glandular hairy
      4. Achenes glandular hairy; exine ornamentation of pollen grains only perforate type with verrucae; La/Lf (La/Lf: ratio of the length of anthers to the length of filaments) of stamens 1.4–1.9; outermost involucrel phyllaries less than 10 mm long, not glandular hairy.....4. *S. namikawae*
      4. Achenes glandular hairy; exine ornamentation of pollen grains a conjugate type with verrucae; La/Lf of stamens 0.5–0.8; outermost involucrel phyllaries more than 28 mm long, glandular hairy.....2. *S. laniceps*
    3. Corollae not glandular hairy
      5. Achenes not glandular hairy
        6. Involucrel phyllaries glandular hairy.....7. *S. leucoma*
        6. Involucrel phyllaries not glandular hairy.....1. *S. medusa*
      5. Achenes glandular hairy
        7. Pappus brown to dark brown
          8. Outermost involucrel phyllaries glandular hairy.....8. *S. quercifolia*
          8. Outermost involucrel phyllaries not glandular hairy
            - .....9. *S. eriocephala*
        7. Pappus white to pale yellow
          9. Outermost involucrel phyllaries glandular hairy
            10. Ll/Lt (Ll/Lt: ratio of length of corolla lobe to length of corolla tube) of corollae 0.22–0.23; La/Lf of stamens 1.5–1.8
              - .....5. *S. gossypiphora*
            10. Ll/Lt of corollae 0.32–0.45; La/Lf of stamens 0.9–1.1
              - .....10. *S. simpsoniana*
        9. Outermost involucrel phyllaries not glandular hairy
          11. Achenes more than 5.0 mm long; Ll/Lt of corolla 0.23–0.45; La/Lf of stamens 1.4–2.0
            - .....1. *S. medusa*
          11. Achenes less than 3.8 mm long; Ll/Lt of corolla 0.21–0.26; La/Lf of stamens 1.2–1.4
            - .....3. *S. tridactyla*
      2. Receptacles not setose; achenes glandular hairy; Ll/Lt of corollae 0.14–0.20; involucrel phyllaries not glandular hairy.....6. *S. nishiokae*
    1. Leaves, stem and residue of degraded samples sparingly lanate (Sect. *Pseudo-eriocoryne*)
      12. Achenes provided with coronules; equatorial diameter of pollen grains 36–40  $\mu$ m.....11. *S. stella*
      12. Achenes devoid of coronules; equatorial diameter of pollen grains 27–33  $\mu$ m.....12. *S. kingii*

The distinctive characteristics of each species were summarized as follows:

1. *Saussurea medusa* (Figs. 1, 2A, 4A, 5A, 6A)

Achenes are 5.0–8.5 mm long. This is one of the species having longest achenes among the 12 species examined. Pappi is sometimes glandular hairy near the base.

2. *Saussurea laniceps* (Figs. 2B, 4B, 5B, 6B)

Exine ornamentation pattern of pollen grains is combined with perforate and verrucate types with verruca.

3. *Saussurea tridactyla* (Figs. 2C, 4C, 5C, 6C)

Involucrel phyllaries and corollae are very similar to *S. medusa* in size and shape, but



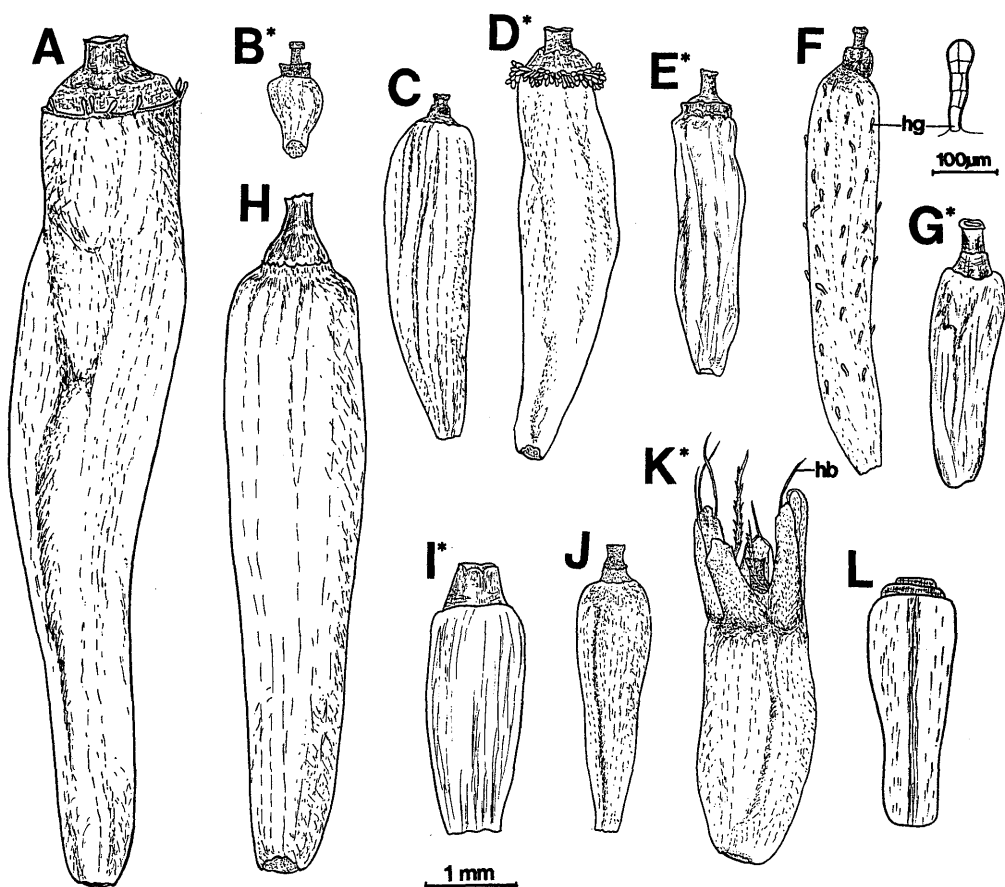


Fig. 4. Achenes of *Saussurea* subgenus *Eriocoryne* species. A. *S. medusa* (Z. D. Fang 715). B. *S. laniceps* (Z. D. Fang 237). C. *S. tridactyla* (Nishioka 1119, KYO). D. *S. namikawae* (Nishioka 447, KYO). E. *S. gossypiphora* (Ohba & al. 8351343, KYO). F. *S. nishiokae* (Namba 1023001). G. *S. leucoma* (R. P. Yang & al. 37). H. *S. quercifolia* (Z. D. Fang 1087). I. *S. eriocephala* (Meili Expedition team 26403). J. *S. simpsoniana* (Namba & al. N-7684). K. *S. stella* (Z. D. Fang 29564). L. *S. kingii* (Kawaguchi 96929, TNS). Abbreviation: con, coronule; hb, bristle; hg, glandular hair). \* immature. In order to emphasize the morphological character of the surface on achenes specimens on various developmental stages are employed. Among species of the genus *Saussurea* mature achenes are generally similar in size (Kadota pers. comm.)

the ratio  $La/Lf$  is 1.2–1.4 and smaller than *S. medusa* and achenes are 3.3–3.8 mm long and is also smaller than *S. medusa*.

4. *Saussurea namikawae* (Figs. 2D, 4D, 5D, 6D)

Floral organs are very similar to *S. medusa* in size and shape, but glandular hairs are observed abundantly on both corollae and

achenes near the base of pappi.

5. *Saussurea gossypiphora* (Figs. 2E, 3, 4E, 5E, 6E)

Achenes are glabrous.

6. *Saussurea nishiokae* (Figs. 2F, 4F, 5F, 6F)

Involucral phyllaries and corollae are very similar to *S. gossypiphora* in size and shape, but receptacles are not setose and achenes

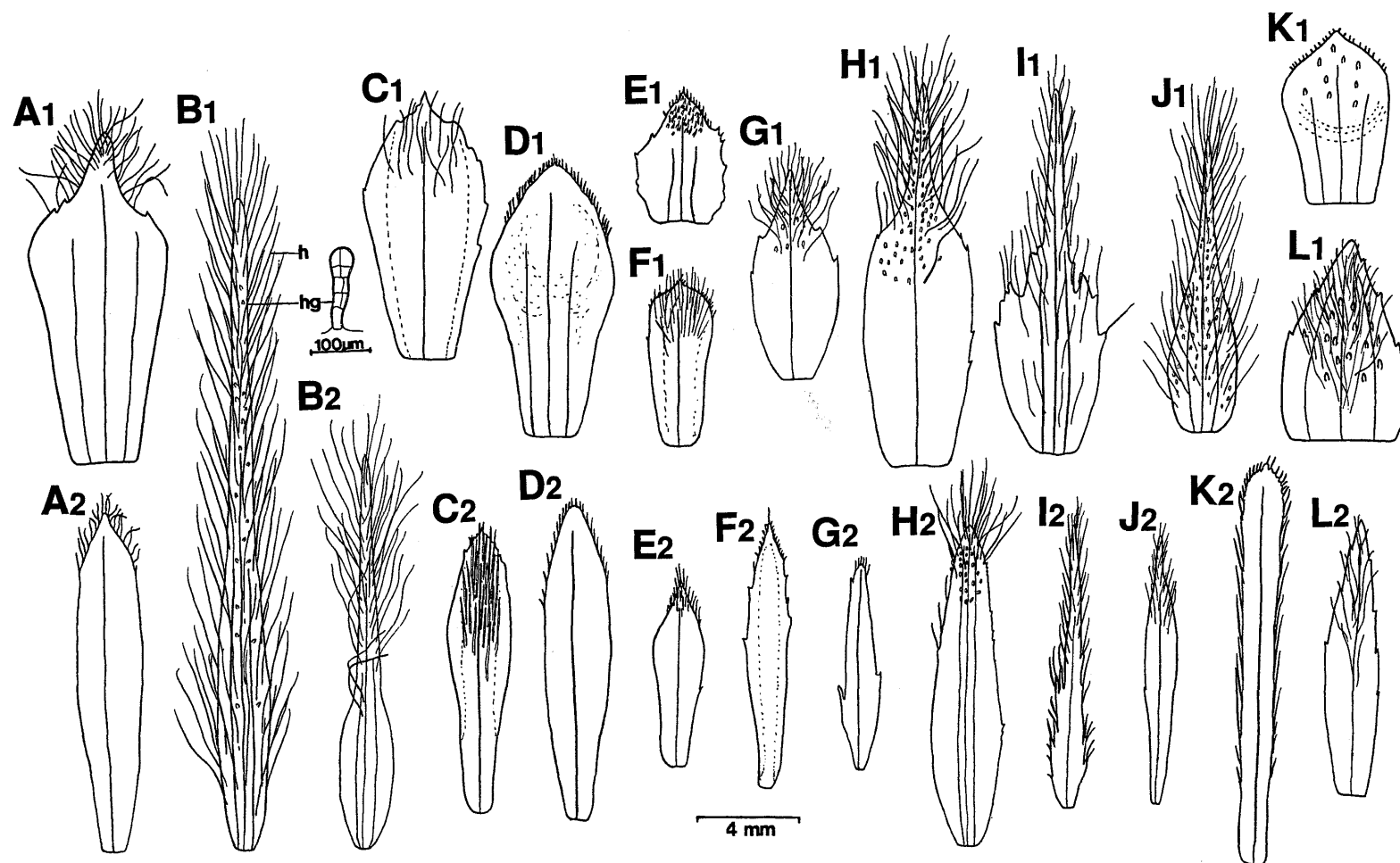


Fig. 5. The outermost involucre phyllaries (1) and the innermost phyllaries (2) of *Saussurea* subgenus *Eriocoryne* species. A. *S. medusa*. B. *S. laniceps*. C. *S. tridactyla*. D. *S. namikawae*. E. *S. gossypiphora*. F. *S. nishiokae*. G. *S. leucoma*. H. *S. quercifolia*. I. *S. eriocephala*. J. *S. simpsoniana*. K. *S. stella*. L. *S. kingii*. Voucher specimens are the same as cited in Fig. 2. Abbreviation: h, hair; hg, glandular hair.

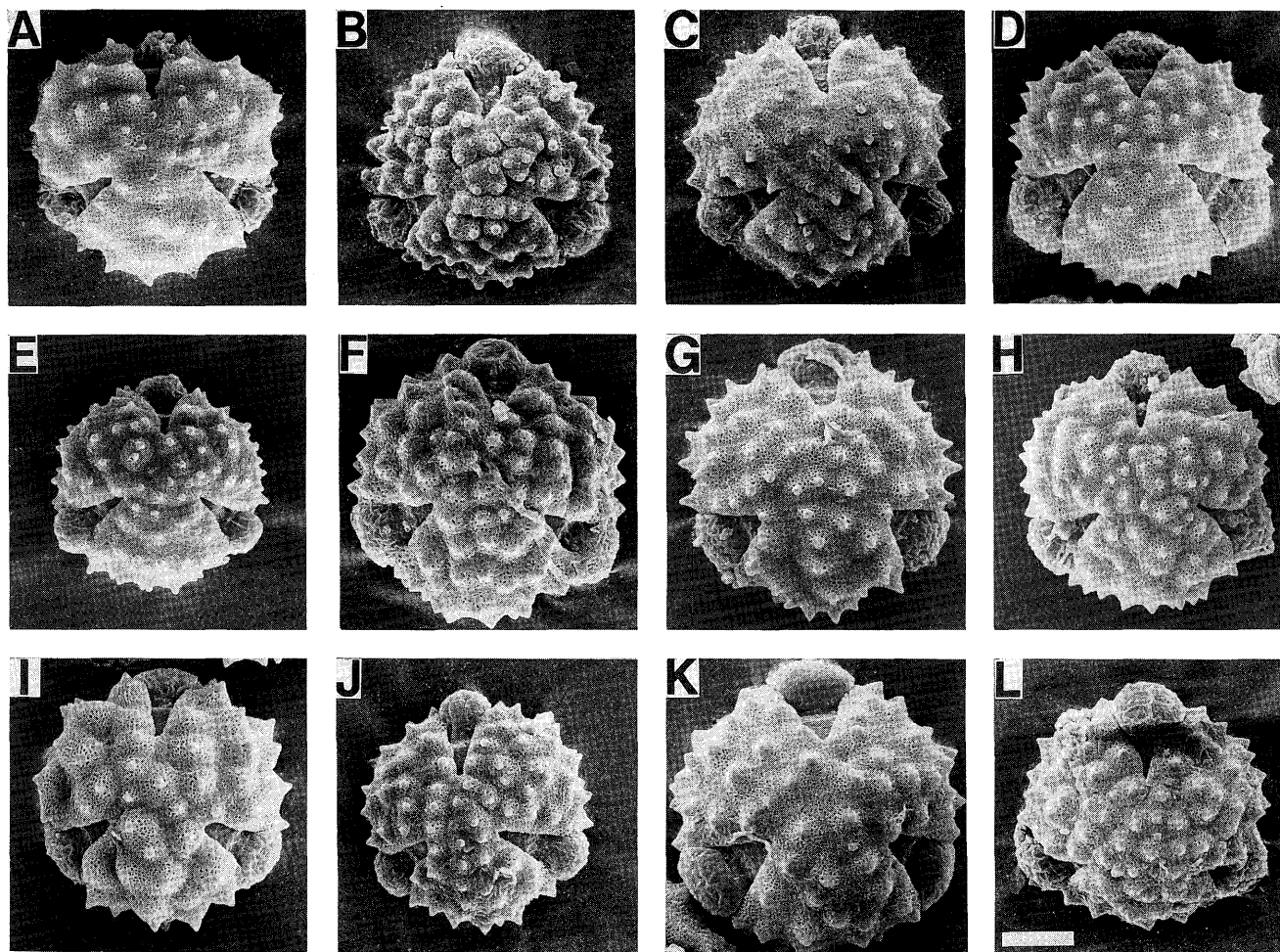


Fig. 6. SEM photographs of pollen grains from *Saussurea* subgenus *Eriocoryne* species. A. *S. medusa*. B. *S. laniceps*. C. *S. tridactyla*. D. *S. namikawae*. E. *S. gossypiphora*. F. *S. nishiokae*. G. *S. leucoma*. H. *S. quercifolia*. I. *S. eriocephala*. J. *S. simpsoniana*. K. *S. stella*. L. *S. kingii*. Voucher specimens cited are the same as cited in Fig. 2. Scale bar = 10  $\mu$ m.

are sparingly glandular hairy throughout the surface.

7. *Saussurea leucoma* (Figs. 2G, 4G, 5G, 6G)

Glandular hairs are observed on both the outermost involucrel phyllaries and achenes and the ratio La/Lf is 1.8–2.4.

8. *Saussurea quercifolia* (Figs. 2H, 4H, 5H, 6H)

Glandular hairs are observed on the outermost involucrel phyllaries.

9. *Saussurea eriocephala* (Figs. 2I, 4I, 5I, 6I)

This species is similar to *S. quercifolia* in appearance and color, but the outermost involucrel phyllaries are lacking glandular hairs and longer than those of *S. quercifolia*, and pollen grains are reddish brown.

10. *Saussurea simpsoniana* (Figs. 2J, 4J, 5J, 6J)

Glandular hairs are observed on the outermost involucrel phyllaries.

11. *Saussurea stella* (Figs. 2K, 4K, 5K, 6K)

Leaves and stem scarcely lanate; achenes provided with coronules at the tip; pollen grains 36–40  $\mu\text{m}$  equatorially, 30–37  $\mu\text{m}$  polarly, this is the largest of all the species examined.

12. *Saussurea kingii* (Figs. 2L, 4L, 5L, 6L)

Leaves and stem sparingly lanate; receptacles not setose.

### Morphological characteristics of crude drugs and their origins

Both samples from Hongkong and Qinghai Province consist of aerial parts, with or without some amounts of roots, and contained woolly hairs. However, the leaves and rhizomes were damaged and did not retain sufficient shape to make anatomical scrutiny possible. Neither large thin bracts nor their fragments, which suggest the derivatives of subgenus *Amphilaena* species of *Saussurea*, were observed. Bristles are observed on the receptacles, but coronules were not recognized at the tip of achenes. Pollen grains

were trizonocolporate, and the exine ornamentation pattern showed verrucate sculpturing.

1. “Xuelianhua” from Hongkong Market (TMPW No. 2255, Fig. 7A)

The sample contains four plant bodies which consist of aerial parts, but most of the leaf blades are broken into pieces too small for thorough anatomical scrutiny. Plant bodies retain only petioles and a certain amount of the flowers on capitulae. The characteristics on the retained flowers are observed as follows: Two plant bodies contain achenes with many glandular hairs around the position where pappi are attached and recognized as *S. namikawae* (1), but very few glandular hairs are observed on achenes of the remaining two bodies (2). Achenes are more than 7 mm long, but partly vermiculated. Glandular hairs are also observed on the corollae of (1), but not on those of (2). Pappi are pale yellow in color. The ratio La/Lf is 1.8–1.9 (1), ca. 1.8 (2), and the ratio Ll/Lt is 0.29–0.31 (1) and 0.32–0.36 (2). The sample was considered to be a mixture of two species; two plant bodies of *S. namikawae* and two plant bodies of flowering *S. medusa*.

2. “Xuelian (also as sPang-rtzi)” from Golmud Market, Qinghai Prov. (TMPW No. 11335, Fig. 7B)

Sample consists of whole plants, but most of achenes and leaves were damaged by insects. Receptacles were setose. Pappi were pale brown in color and with somewhat darker brown in color like flecks. Corollae and achenes from capitula and dropped residues were investigated. The portion of the achenes where pappi attached was found out in the residues, but no glandular hairs were found. Glandular hairs were observed on involucrel phyllaries, but not on corollae. These characteristics agreed with those of flowering *S. quercifolia*.

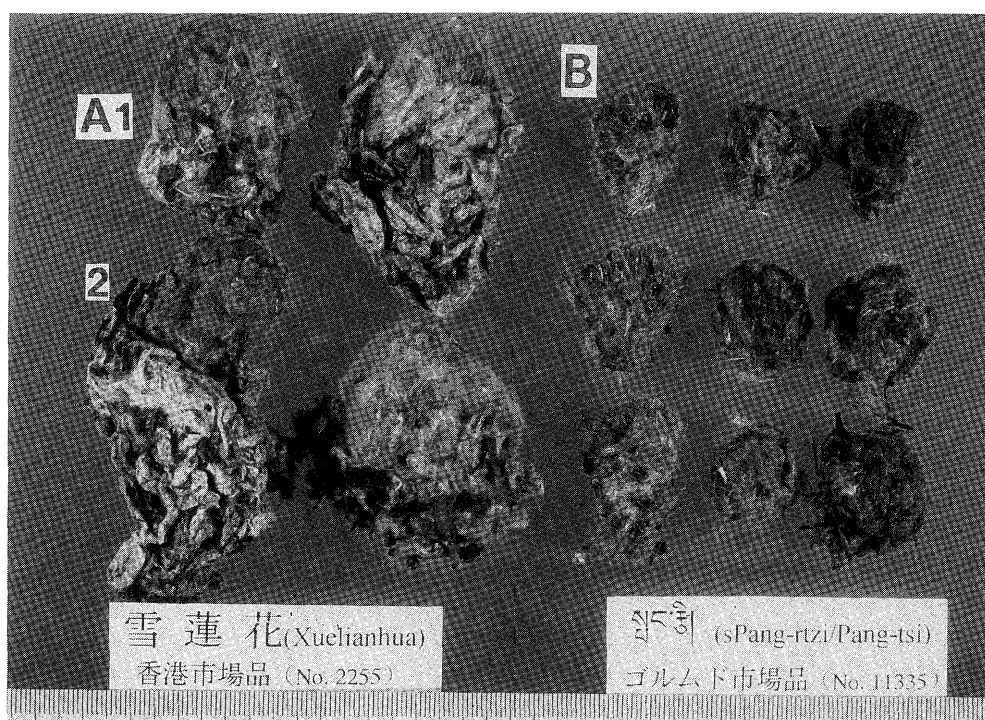


Fig. 7. Chinese crude drug, “Xuelianhua (雪蓮花, A)” and Tibetan crude drug, “sPang-rtzi (B)”. TMPW registration No. and the botanical origins of each sample are 2255, *Saussurea namikawae* (A1) and *S. medusa* (A2), and 11335, *S. quercifolia*, respectively. The name of “Xuelianhua” is expressed in Chinese and “sPang-rtzi” in Tibetan characters.

### Conclusion and Discussion

1. The botanical origin of the commercial sample of “Xuelianhua” obtained from Hongkong market was determined to be derived from a mixture of whole plants (in flower) of two plant bodies of *S. namikawae* and two plant bodies of *S. medusa*. “Xuelian” obtained from Golmud market, Qinghai Province, China, was determined to be derived from *S. quercifolia*.

2. The clavate hairs on the achenes, corollae and involucre phyllaries were recognized to be glandular hairs composed of a uniseriate or biseriate multicellular stalk with a multicellular head. Bristles were identified as emergences.

3. Crude drugs derived from other subgen-

era, such as *Amphilaena* and *Saussurea*, can also be broken under the same condition as the materials on this paper. In plants from subgen. *Amphilaena*, the large thin bracts readily decompose, but fragments of these bracts may be found in the residue. In plants from subgen. *Saussurea*, capitula are arranged in a corymb and are not crowded as subgen. *Eriocoryne*, and long hairs are very sparse comparing with sect. *Eriocoryne* of subgen. *Eriocoryne*. Such samples have not been found up to present, however, some Tibetan materia medica, such as *Kon-pa-gab-skyes*, *sPhyang-dug-pa* and *lCe-zhur*, said to be derived from the subgen. *Saussurea* plants, are used medicinally (Biology Institute of Qinghai 1972, 1978). Therefore,

further morphological and anatomical study is necessary.

4. *Saussurea medusa* is quite similar to *S. namikawae* in morphological attributes. From the viewpoints of the interspecific differences, their original descriptions can be summarized as follows; corollae are purple in color and nearly overtopping limbs, receptacles are small and extremely short like palea, achenes are smooth in *S. medusa* (Maximowicz 1881); corollae are purplish in color and minutely pilose, receptacles are setose and white, short and curly hairs are observed on the apex of achenes in *S. namikawae* (Kitamura 1969). Our results show that corollae and achenes are glandular hairy. Maximowicz did refer to any hairy organs on neither corollae nor achenes in *S. medusa*. Recently, Lipschitz (1979) and Shih and Jin (1999) reduced *S. namikawae* to a synonym of *S. medusa* in their monographs. They did not mention the presence of short hairs except woolly hairs which are obviously observed on the whole plant body. The other morphological characteristics of these two species are so similar to each other, therefore, further study is necessary.

5. The sample of the crude drug of "Xuelian" (TMPW 11335) was also used as the Tibetan crude drug, "sPang-rtzi". "sPang-rtzi do-bo" including "sPang-rtzi" was shown to be derived from whole plants of *Pterocephalus hookeri* (C.B. Clarke) Diels (Dipsacaceae) (Yamaji et al. 1993). Its validity for official use was also ascertained from the historical evidences by surveying herbal literatures, i.e., "Vaidurya sngon-po (1687)" and "Shel-gong shel-phreng (1727)." According to these literatures, "sPang-rtzi do-bo" in a wide sense consists of three types of drugs in a narrow sense, "sPang-rtzi do-bo," proper, "sPang-rtzi byar-bag-can," and "Lug-rtzi do-bo." "Lug-rtzi do-bo" was suggested to be derived from woolly *S. quercifolia* with darker brown pappi by the description in the literature (1727), "Flowers are covered with

woolly hairs. Some flecks are observed (= darker pappi can be observed as flecks)." In this study, we have found out that whole plants of *S. quercifolia* are also as one of the origins of "sPang-rtzi".

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楊 瑞萍<sup>a</sup>, 小松かつ子<sup>b</sup>, 佐藤利江<sup>b</sup>, 難波恒雄<sup>b</sup>, 山路誠一<sup>b</sup>: “雪蓮花”類植物の生薬学的研究 (第4報). トウヒレン属 *Eriocoryne* 亜属 (キク科) に由来する漢薬 “雪蓮花” およびチベット薬物 “sPang-rtzi” について

我々は前報までに、キク科トウヒレン属 (*Saussurea*) *Eriocoryne* 亜属および *Amphilaena* 亜属に由来する中薬の『雪蓮花』およびそれらに関連する生薬の基源について、比較組織学的に確証してきた。しかし、市場に出回っている幾つかのサンプルは虫害や輸送途中のダメージで葉を欠いていたため、組織学的な精査が不可能であった。一方、これらサンプルの断片には多量の綿毛が認められたことから *Eriocoryne* 亜属であることが知られた。このような商品の基源を明らかにするため、第2報で報告した *Eriocoryne* 亜属12種のトウヒレン属植物を比較材料として花、瘦果、花粉粒について、

実体顕微鏡及び走査型電子顕微鏡を用い解剖学的及び形態学的観察を行った。検討の結果12種の *Eriocoryne* 亜属植物は花床における剛毛の有無、瘦果の小冠の有無、冠毛の色、総苞片、花冠、瘦果における腺毛の有無、花粉粒外壁のオーナメンテーションの相違等により区別可能であった。以上をもとに生薬の同定を試み、香港市場の『雪蓮花』は *Saussurea namikawae* および *S. medusa* の混合品、青海省ゴルムド市場品の『雪蓮』(チベット薬物『sPang-rtzi』としても使用)は *S. quercifolia* の、それぞれ開花期の全草であることを明らかにした。

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